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Deaths From Bites and Stings of Venomous Animals

FRANKLIN ENNIK, MA, *Berkeley, California*

Data abstracted from 34 death certificates indicate that the three venomous animal groups most often responsible for human deaths in California from 1960 through 1976 were Hymenoptera (bees, wasps, ants and the like) (56 percent), snakes (35 percent) and spiders (6 percent). An average incidence of 2.0 deaths per year occurred during these 17 years, or an average death rate of 0.01 per 100,000 population per year. Nearly three times more males than females died of venomous animal bites and stings. Half of the deaths from venomous snake bites occurred in children younger than 5 years of age. Susceptible persons 40 years or older appeared to be particularly vulnerable to hymenopterous insect stings and often quickly died of anaphylaxis. Fatal encounters with venomous animals occurred more often around the home than at places of employment or during recreational activities. Deaths resulting from spider bites are rare in California but many bites are reported. Medical practitioners are urged to seek professional assistance in identifying offending animals causing human discomfort and to use these animals' scientific names on death certificates and in journal articles.

ANIMALS THAT PRODUCE toxins are classified as either venomous or poisonous.[1] Venomous animals are those that are capable of producing a toxin in a specially developed secretory organ or group of cells, and can deliver this toxin during a stinging or biting act via an apparatus, such as stings or spines or by contact hairs, teeth, beaks or fangs. This category includes stone fish, stingrays, snakes, spiders, scorpions, ticks and insects such as Hymenoptera (bees, wasps, ants and the like), caterpillars and conenose bugs. Poisonous animals are those creatures whose tissues, either in whole or in part, are toxic, such as puffer fish, toads and newts.

In an analysis of human deaths attributable to venomous animals that occurred in the United States from 1950 through 1959, Parrish[2] found that hymenopterous insects, snakes and spiders were the three animal groups most often responsible. Since 1963 data have been summarized for Florida,[3] Mississippi,[4] and England and Wales.[5] Parrish[2] included in his report for the United States the deaths in California attributed to bites and stings of venomous animals during 1950 to 1959. This study also summarizes data on human

Mr. Ennik is Medical Entomologist, Vector Biology and Control Section, California Department of Health Services, Berkeley, California.

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Reprint requests to: Mr. Franklin Ennik, Vector Biology and Control Section, California Dept. of Health Services, 2151 Berkeley Way, Berkeley, CA 94704.

deaths resulting from venomous animal bites and stings that occurred in California from 1960 through 1976.

Methods

Copies of death certificates coded under the International Classification of Diseases Adapted (ICDA),[6] "Bites and Stings of Venomous Animals and Insects," for the years 1960 through 1976, were obtained from the Vital Statistics Section of the California State Department of Health Services. The ICDA codes E927 (7th edition, 1957) and E905 (8th edition, 1967) include fatalities resulting from bites or stings of venomous sea animals, venomous lizards and snakes, centipedes, spiders, scorpions, bees, wasps and unspecified insects. Excluded are fatalities caused by nonvenomous animals such as dogs, cats, farm animals, birds, nonvenomous snakes (constrictors) and nonvenomous insects. The following information was abstracted and summarized from the death certificates: the age, sex and occupation of the deceased; the town and county where the accident occurred; the date, time, place and cause of death; the animal presumed to have been the cause of death, and the time between the injury and death.

TABLE 1.—*Deaths and Venomous Animals Responsible for Fatalities in California, 1960-1976, Compared With 1950-1959**

Animal	1950-1959* Number of Deaths	1950-1959* Percent	1960-1976 Number of Deaths	1960-1976 Percent
Hymenoptera	18	56	19	56
Venomous snakes	12	38	12	35
Spiders	1	3	2	6
Unspecified insect	..	..	1	3
Other	1	3	..	..
TOTAL	32	100	34	100

*Data adapted from Parrish.[2]

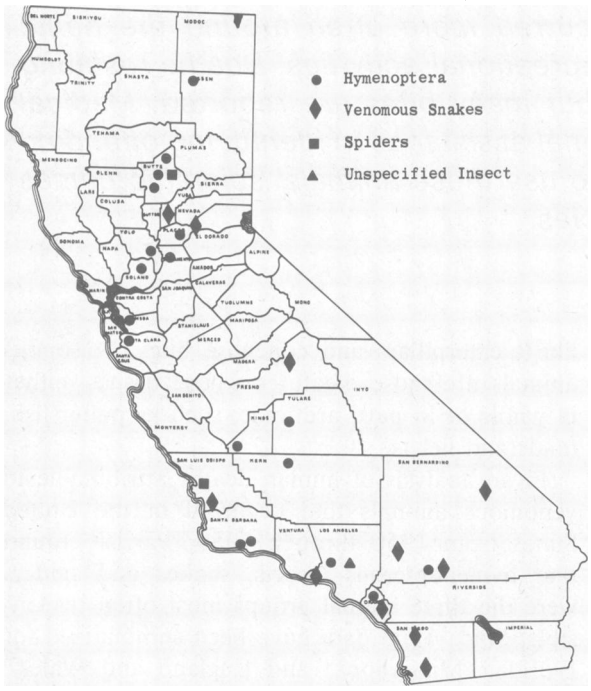

Figure 1.—Locations where bites and stings occurred that resulted in human deaths. Each symbol represents one death. Two deaths of California residents that occurred out-of-state are not indicated.

Results and Discussion

Parrish[2] reported 32 human deaths attributed to bites and stings of venomous animals in California from 1950 through 1959, or an average incidence of 3.2 deaths per year. The results of the present study indicate that 34 deaths occurred as a result of venomous animals from 1960 through 1976 (Table 1). This represents an average of 2.0 deaths per year for this 17-year period and an average death rate of 0.01 per 100,000 population per year (range 0 to 0.036).

In this study, the numbers of deaths categorized by cause (Table 1) are similar to those reported by Parrish.[2] Nineteen deaths (56 percent) were caused by hymenopterous insects: bees (14), wasps (4), and yellowjackets (1). Twelve deaths (35 percent) were caused by venomous snakes: rattlesnake (8), king cobra (1) and "poisonous snake" (3). Two deaths (6 percent) were attributed to spiders and one (3 percent) to an unspecified insect. No deaths attributed to other venomous animals such as marine animals, ants, caterpillars, centipedes, scorpions, ticks and poisonous lizards, were reported in California during this period.

Figure 1 illustrates the localities in California where the fatal bites or stings occurred. Obvious concentrations appear in the distribution of deaths. The concentration of fatalities from hymenopterous insect stings in the Sacramento Valley and lower San Joaquin Valley correlates with the large number of bee colonies commercially kept in these areas for agricultural purposes. However, there is no direct evidence that the commercially kept bees are responsible for these deaths. Although beekeeping was not listed as an occupation of any person in this study, most deaths due to Hymenoptera stings occurred "at

home." Because honey bees are necessary for the economic well-being of these farming communities their presence may be tolerated in the adjacent suburban areas as well, even though the bees are a potential health threat.

The concentration of deaths from snakebites in Southern California may be due, in part, to the large number of rattlesnake species that occur in the diverse habitats of that region. In addition, the daily and seasonal activity periods of rattlesnakes in this area may be prolonged compared with other regions, which may permit more frequent accidental contact with humans. Also, many species of exotic and indigenous venomous snakes are housed in private and scientific collections in Southern California.[7]

There were nearly three times more deaths among males than females between 1960 and 1976 (Table 2). This difference possibly reflects the greater exposure of males to venomous animals because they spend more time in outdoor activities. However, the number of fatalities among men and women may equalize in the future because of changes in women's occupational and recreational patterns.

Nearly all age groups are represented in the distribution of victims (Table 3). Half of the recorded fatalities due to snakebites occurred among children younger than 5 years of age. Children appear to be particularly vulnerable to snakebites not only because of their small size and curiosity, but also because most young children have not yet learned to recognize venomous snakes or to give them the respect they deserve.

Sixteen deaths or 84 percent of the recorded fatalities due to Hymenoptera stings occurred in persons 40 years of age or older. People younger than 40 years apparently are less susceptible to fatal stings of Hymenoptera because hypersensitivity to the venom has not yet developed. Somerville and co-workers[5] observed a substantial increase in the number of fatalities among persons older than 40 years in their study of 61 deaths caused by Hymenoptera stings in England and Wales.

Table 4 lists the times of day when the injuries (envenomations) occurred and the approximate interval from envenomation until death for each victim. For the most part, fatal Hymenoptera stings occurred during daylight hours, reflecting the insects' period of greatest activity and potential contact with humans. Apparently, most victims were unable to obtain medical help in time and died within an hour, in most cases (14 of 19) because of anaphylactic shock. Most deaths caused by Hymenoptera were attributed to a single "sting," although two death certificates indicated that the persons had died from "multiple" stings.

Some allergists[8,9] believe that about 1 percent of the general population is hypersensitive to Hymenoptera venom. This means that up to some 2 million people in the United States or about 220,000 in California could be hypersensitive to these toxins.

Bites from venomous snakes occurred most frequently in the afternoon and early evening hours. With the exception of small children, who succumbed soon after envenomation, the victims

TABLE 2—*Deaths by Year and Sex of Victims of Bites and Stings in California, 1960-1976*

Year	Females	Males	Deaths
1960	..	..	..
1961	1	1	2
1962	..	2	2
1963	..	1	1
1964	1	..	1
1965	..	..	..
1966	..	4	4
1967	2	5	7
1968	..	3	3
1969	..	..	..
1970	1	..	1
1971	1	2	3
1972	..	..	..
1973	..	3	3
1974	..	3	3
1975	..	1	1
1976	1	2	3
TOTAL	7	27	34

TABLE 3.—*Age Distribution of Victims Who Died From Bites and Stings of Venomous Animals in California, 1960-1976*

Age of Victim (Years)	Venomous Snake Bites	Hymenoptera Stings	Spider Bites	Unspecified Insect Bite	Deaths
0-4	6	..	..	..	6
5-9	..	..	..	..	..
10-19	..	2	..	1	3
20-29	2	1	..	..	3
30-39	1	..	..	..	1
40-49	1	5	2	..	8
50-59	..	5	..	..	5
60-69	..	6	..	..	6
70 & older	2	..	..	..	2
TOTALS	12	19	2	1	34

survived several hours to several days after being bitten. Because the venom is absorbed primarily through the lymphatic system and to a lesser degree directly into capillaries, there is a delay of some hours before the toxin affects vital organs. The only death between 1960 and 1976 attributed to a venomous animal not native to California occurred when a professional snake handler was bitten while attempting to force-feed a king cobra.

Deaths resulting from spider bites are rare in California. However, the number of people bitten per year is greater than is generally realized. Statistical data maintained at two regional poison centers (A. S. Manoguerra, PharmD, University of California, San Diego, written communication, August 1979, and S. Stowe, RN, University of California, Davis, written communication, April 1979) show approximately 100 calls per year at each center regarding spider bites. The Vector Biology and Control Section of the California Department of Health Services responds to between 45 and 75 inquiries per year on real and suspected spider bites. Russell[10] stated that he saw 27 victims of black widow bite over three years in the greater Los Angeles area. One death certificate in the present study alleged that the ". . . deceased [was] bitten on [the] neck by an insect [sic], presumed to have been a black widow. . . ." The bite later had become infected. The other death certificate examined, which attributed death to a spider bite, alleged that the victim was ". . . apparently bitten by a spider. . . ." Medical entomologists of the California Department of Health Services investigated the latter case but failed to find evidence indicating the presence of either black widow spiders (*Latrodectus* sp) or violin spiders (*Loxosceles* sp) in the locale where the victim had been reported bitten. These two genera are usually implicated in human deaths from spider bites. *Latrodectus* spiders are found throughout California, mainly at lower elevations. One or more indigenous species of *Loxosceles*

TABLE 4.—*Injury and "Immediate Cause" of Death in Victims of Stings and Bites of Venomous Animals in California, 1960-76*

Injury	*Approximate Time of Day (Pacific Standard Time)*	*Approximate Interval to Death*	*"Immediate Cause" (According to Death Certificate)*
Bee sting	0600	½ hour	Anaphylactic shock
Bee stings	0800	½ hour	Acute pulmonary edema
Bee sting	0915	2 hours	Anaphylaxis
Bee sting	1000	Not stated	Acute asthmatic bronchitis
Bee sting	1150	1 hour	Anaphylaxis
Bee sting	1300	<½ hour	Anaphylactic shock
Bee sting	1300	½ hour	Anaphylactic shock
Bee sting	1430	<1 hour	Asphyxia
Bee sting	1725	½ hour	Intoxication due to bee sting
Bee sting	1800	¾ hours	Anaphylaxis
Bee sting	1800	½ hour	Anaphylactic shock
Bee sting	1800	2 hours	Anaphylactic reaction
Bee sting	2130	8 hours	Anaphylaxis
Bee sting	Unknown	Unknown	Anaphylactic shock
Wasp sting	0730	<1½ hours	Anaphylactic shock
Wasp sting	1030	1 hour	Anaphylactic shock
Wasp sting	1500	1½ hours	Passive congestion of heart
Wasp sting	1800	4 hours	Anaphylaxis
Yellowjacket stings	Unknown	2 days	Coronary occlusion—shock
Rattlesnake bite	0900	1 day	Not stated
Rattlesnake bite	1100	3 hours	Not stated
Rattlesnake bite	1400	18 hours	Hemolysis
Rattlesnake bite	1430	4½ days	Cardiorespiratory failure
Rattlesnake bite	1500	14 hours	Respiratory paralysis—toxemia
Rattlesnake bite	1900	7 hours	Acute pulmonary congestion
Rattlesnake bite	1900	<1 day	Not stated
Rattlesnake bite	Unknown	<½ hour	Hemolysis
King cobra bite	1800	<½ hour	Pulmonary emphysema atrophy
Snake bite	1315	4 hours	Acute toxemia
Snake bite	1800	Unknown	Cardiorespiratory failure
Snake bite	1815	3½ days	Cardiorespiratory failure
Black widow spider bite	Unknown	8½ days	Myocarditis and pericarditis
Spider bite	Unknown	9½ days	Cardiac arrest (septicemia)
Insect bite	Unknown	7 days	Septicemia from cutaneous abscess

spiders occur in the desert habitats of Southern California and at least one exotic *Loxosceles* species has become established in the San Gabriel Valley area of Los Angeles County.[11] Parrish[2] reported two deaths caused by *Loxosceles* spiders and 63 deaths attributed to bites by *Latrodectus* spiders in the United States between 1950 and 1959.

The seasonal distribution of deaths caused by venomous animals is summarized in Table 5. Although accidental encounters with venomous snakes can occur at any time in certain geographic areas, humans are at particular risk of being bitten by these animals beginning in April in some western states. Rattlesnakes begin to emerge from their sites of winter hibernation to forage or bask in the sun at this time or at other times when ambient air temperatures increase. Although some species of rattlesnake appear to be sluggish or less pugnacious than others, all should be considered dangerous during any season of the year.

The seasonal pattern of human fatalities from Hymenoptera stings corresponds to the seasonal increase and decrease of the foraging insect populations. In the spring when the weather becomes favorable, humans and Hymenoptera increase their outdoor activities. Close encounters often result in stings that are sometimes fatal. The occurrence of fatal stings reaches a peak in late summer and abruptly decreases when winter weather approaches.

The use of data from death certificates to determine the incidence of deaths from venomous animals leads to an underestimation of the actual number because of misdiagnoses. Many fatalities that have occurred outdoors, which were classified as heat strokes or heart attacks, might actually have been allergic reactions to insect stings.[12] Also, examining physicians may not have recognized insect stings as a cause of death, especially when an accident with an automobile[13] or equipment was involved. Two death certificates examined during this study indicated that the victims had suffered fatal Hymenoptera stings while operating motor vehicles. Additional deaths attributable to insect stings might have been recorded under other ICDA codes or classifications.

Although the number of death certificates examined during this study was small, the data suggest certain trends. Fatal encounters with venomous animals occurred more often at home than at work or during recreational activities (Table 6). This was particularly true for cases of Hymenoptera stings. Bee stings and yellowjacket stings appear to occur more often in suburban environments than in rural or farming areas. These particular insects are often tolerated as beneficial animals, even though they are potentially life threatening. In contrast, venomous snakes are not tolerated in or near suburban areas and seem to be the most prevalent cause of fatalities in rural or wild areas.

Equal numbers of deaths attributed to bites and stings of venomous animals were reported from January 1960 through June 1968 as from July 1968 through December 1976. In the first period 10 deaths resulted from snake bites while in the second period they were responsible for only 2 of 17 deaths. In contrast, only 6 of 17 deaths in the first period were due to Hymenoptera stings, but 13 deaths were caused by these insects in the second period. A general migration toward new suburban developments by city dwellers not familiar with the hazards of the countryside may explain some of the fatalities during the latter period.

Often, the animals responsible for the fatalities are indicated on death certificates by their common or vernacular names. For example, the name wasp is a broad term that includes yellowjackets

TABLE 5.—*Human Deaths Attributed to Bites and Stings of Venomous Animals by Month in California, 1960-1976*

Month	Venomous Snake Bites	Hymenoptera Stings	Spider Bites	Unspecified Insect Bite	Deaths
Jan	..	..	..	..	..
Feb	..	..	..	..	..
Mar	..	..	..	..	..
Apr	3	..	..	..	3
May	2	1	..	..	3
Jun	1	2	..	..	3
Jul	4	3	1	..	8
Aug	..	..	..	1	1
Sep	..	6	..	..	6
Oct	1	5	..	..	6
Nov	..	1	1	..	2
Dec	1	1	..	..	2
TOTALS	12	19	2	1	34

TABLE 6.—*Place Where Fatal Encounters With Venomous Animals Occurred*

Animal	Home	Work	Recreation	Unstated	Total
Hymenoptera	9	5	2	3	19
Venomous snakes	4	2	6	..	12
Spiders	1	..	..	1	2
Unspecified insect	..	..	1	..	1
TOTALS	14	7	9	4	34

and hornets among others. Bee is a similar broad term which includes honey bees among others. The accuracy of using such terms as spider, wasp, bee, honey bee, yellowjacket, hornet and, perhaps, rattlesnake on death certificates *and* in medical literature for descriptive purposes is open to question. These terms, often in combination with various colors, are not descriptive in any scientific sense when used without also giving the animal's scientific name. Furthermore, these common names, as used by the lay public and in medical literature, often refer to different genera and species in various geographic regions of the country.

Animal venoms differ remarkably in their composition and modes of action. The following examples illustrate the importance of specificity in the identification of the offending animals. Recent studies on Hymenoptera venom suggest that the venom components of some vespid genera are qualitatively, but not necessarily quantitatively, similar for phylogenetically related species.[14] Similarly, the effects of venom on humans of the many species in the scorpion genus *Centruroides* in the United States vary, according to species, from transient local pain to serious neurological effects. It is likely that the numerous reports of necrotic arachnidism now being attributed to the spider genus *Loxosceles,* particularly in locales where they are not endemic or not likely to be found, will be traceable to other species of spiders.[15] Unfortunately, physicians often have to rely on descriptions by their patients, who did not capture the arthropods.

As an entomologist and a biologist, I urge medical practitioners to seek professional assistance in identifying the genus or species name of animals that have caused discomfort or illness in their patients and to use these names in scientific reporting and on death certificates. Whenever possible, patients or friends should be urged to capture (taking precautions to avoid exposure) and submit the offending animal for identification.

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